

Ice Grain Accelerator with Charge Detection Mass Spectrometry,  
Phase I

Completed Technology Project (2018 - 2019)



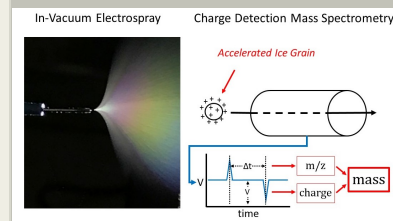
## Project Introduction

NASA has need for laboratory simulations of high velocity impacts with ice particles in order to test in-situ instruments intended for sampling material from planetary bodies such as comets and the water ice plumes of Enceladus. Specifically, beams of micrometer-size water ice grains moving in vacuum at speeds of 5 km/s or higher would be very useful. Light gas guns produce showers of high velocity ice grains that are not well controlled or well characterized, and are not easily combined with the sensitive instrumentation to be tested. Free jet molecular beam sources cannot reach velocities much greater than 2 km/s. The goal of the phase I effort is to develop and characterize an in-vacuo electrospray generator of highly charged ice grains suitable for controlled electrostatic acceleration to hyper-velocities. We will characterize the mass, charge, and speed of the ice grains using RadMet's existing charge detection mass spectrometer hardware. The six-month effort will establish the feasibility of producing ice grains with suitable size and charge inside the vacuum chamber and develop strategies for combining the ice grain source with high voltage accelerating potentials in phase II.

## Anticipated Benefits

The ICE grain accelerator apparatus is envisioned to be adaptable to a variety of existing vacuum systems and could find use in a number of test chambers at various NASA centers. Further development of the core charge detection mass spectrometry technology could benefit the development of NASA in-situ instruments such as cosmic dust analyzers, and detectors for characterizing Lunar and Martian surface electrostatics.

Charge Detection Mass Spectrometry (CDMS) is currently being used to characterize large macromolecules such as viruses. It is valuable for measuring the electric charge on particles in the pharmaceutical and agricultural industries and in the xerographic printing field. RadMet is working towards commercialization of an inexpensive sensor for determining the size and electric charge of aerosol particles based on the CDMS techniques.

Ice Grain Accelerator with  
Charge Detection Mass  
Spectrometry, Phase I

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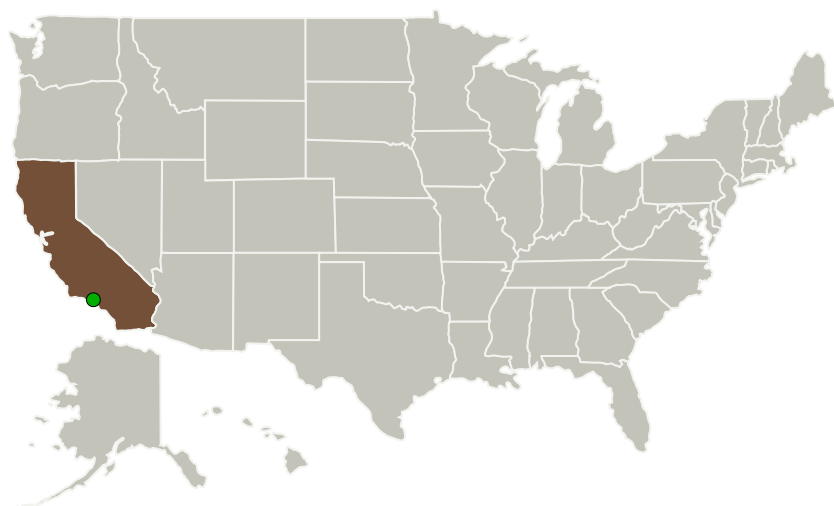
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
RadMet, LLC	Lead Organization	Industry	San Mateo, California
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

## Primary U.S. Work Locations

California

## Project Transitions

**July 2018:** Project Start**February 2019:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/141103>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

RadMet, LLC

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

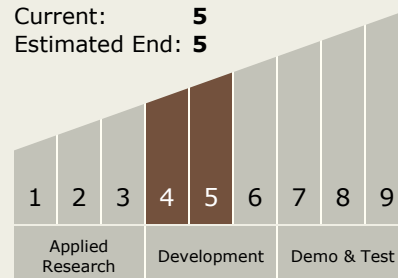
Carlos Torrez

**Principal Investigator:**

Stephen Fuerstenau

## Technology Maturity (TRL)

Start: **4**  
 Current: **5**  
 Estimated End: **5**

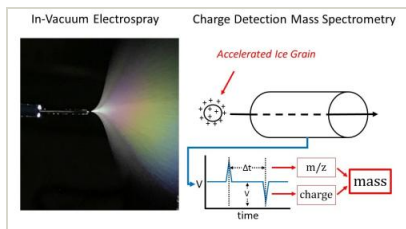


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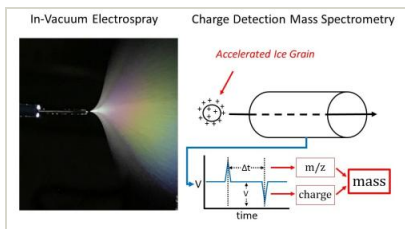
## Images



### Final Summary Chart Image

Ice Grain Accelerator with Charge Detection Mass Spectrometry, Phase I

(<https://techport.nasa.gov/image/132397>)



### Project Image

Ice Grain Accelerator with Charge Detection Mass Spectrometry, Phase I

(<https://techport.nasa.gov/image/134627>)

## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
  - └ TX08.1.4 Microwave, Millimeter-, and Submillimeter-Waves

## Target Destinations

The Moon, Mars, Others Inside the Solar System